# *Mitigating the Fixed Wireless Spectrum Crunch*

*Spectrum is a Finite and Precious National Resource,*
*it Cannot be Manufactured.*
*Therefore*
*the Focus Must be on*
*Continually Increasing the Effective Use of Spectrum*
*through Innovation.*

# The Cause of the Fixed Wireless Spectrum Crunch

Lack of Innovation[1]

Continuing application of 1970s based technology[2]

1. There has been more innovation in mobile wireless in the last four years than there has been in fixed wireless in the last forty years.

2. Entities with large market shares using1970s based technologies (T1 Carrier, FDD PTP radios, plain old dish antennas) continually oppose the introduction of innovative new technologies .

# The Cause of the Fixed Wireless Spectrum Crunch

Legacy (1970s) Point-To-Point Frequency Domain Technology with Dish Antennas

Originally designed for the transport of Symmetrical Voice traffic in a low density environment -- one central office or private branch exchange every 100 sq. miles.

When applied to the **21st Century** need for Asymmetrical Ethernet transport in high density (4G BH and Access) environments – hundreds to thousands of locations every 100 sq. miles.

Results in:

- Wasted Spectrum
- Locations where No New Applicant Paths can be deployed
- Dramatically Increases the Cost of New Paths that do Prior Coordinate
- The Potential to Block Numerous New Paths

# PART 1
# Innovative Solutions to the Fixed Wireless Spectrum Crunch under Existing Rules

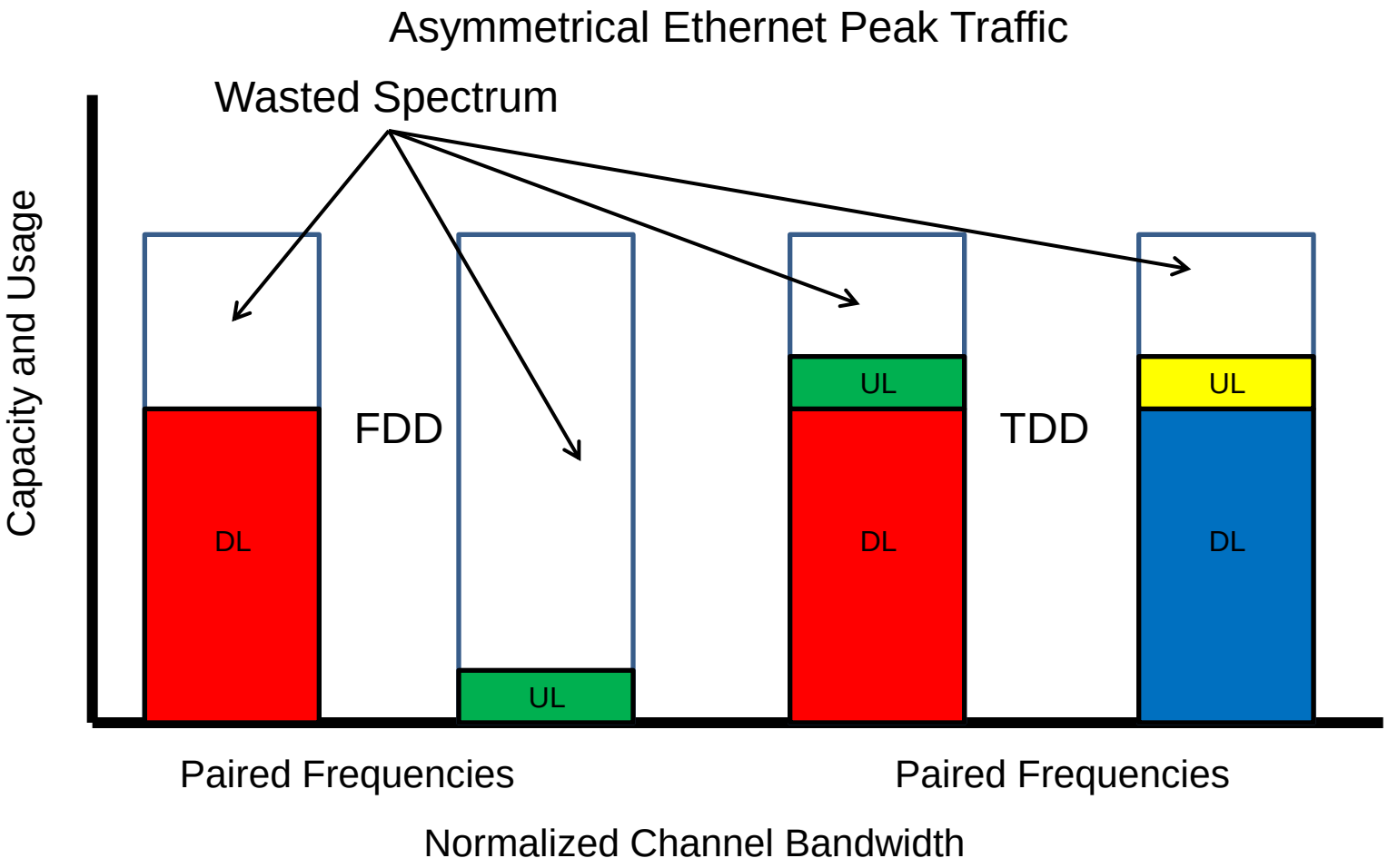
## Innovate -Think in Multiple Dimensions – Mitigate Interference

- Operate in the Time and Frequency Domains (TDD, TDD-TDMA, FDD, FDD-TDMA)
- Use 21st Century Antenna System Technology

## Result

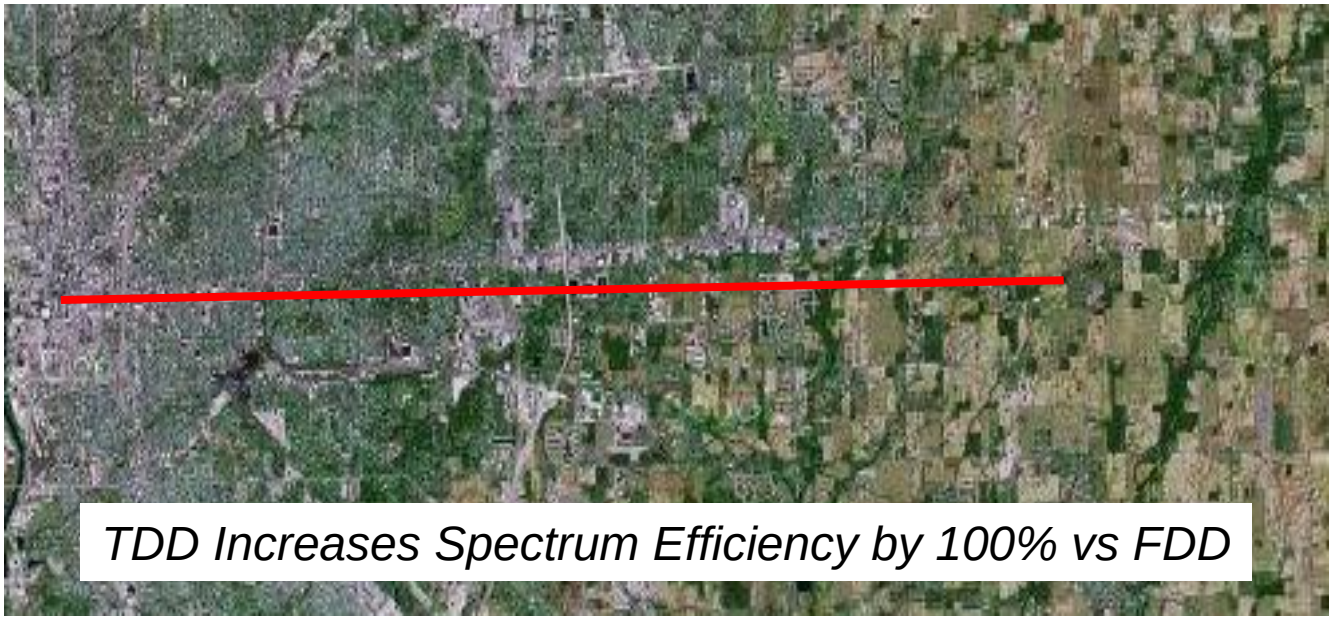
- Dramatic Increase in the Effective Use of Spectrum
- Dramatically Lower Costs for 4G backhaul and access

# Legacy FDD vs TDD
# TDD Doubles Spectrum Efficiency



# Asymmetrical Ethernet Application - One Path

(Paired Frequency with 30MHz Channel BW)




FDD:120Mb Pk DL, 20Mb Pk UL
TDD: 240Mb Pk DL, 40Mb Pk UL

# Asymmetrical Ethernet Application – Eight Paths

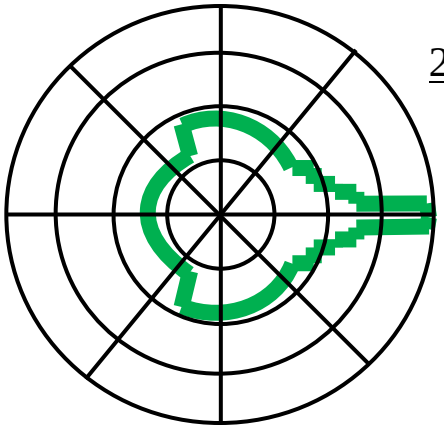
(Paired Frequency with 30MHz Channel BW)


FDD: Not doable – would require Eight Paired Frequencies (480MHz BW)

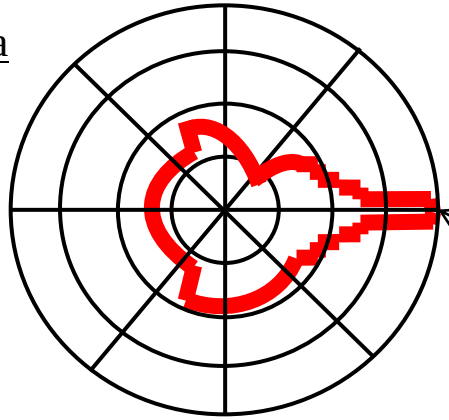
TDD -TDMA : All Eight served by One Frequency Pair (60MHz at x2 Data Rate of FDD)

# Benefits from the use of 21st Century Antenna System Technology

Example: Prior Coordination shows that the EIRP must be reduced by 20dB at 40 degrees



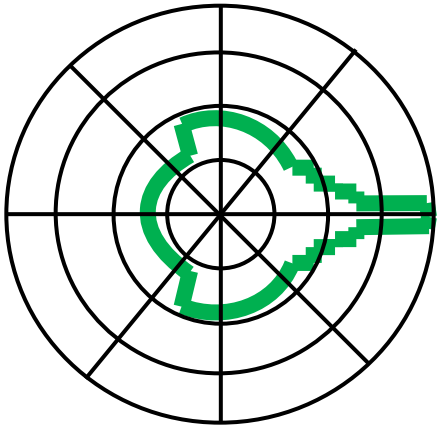
21st Century Antenna



Min power necessary for desired communications remains unchanged.

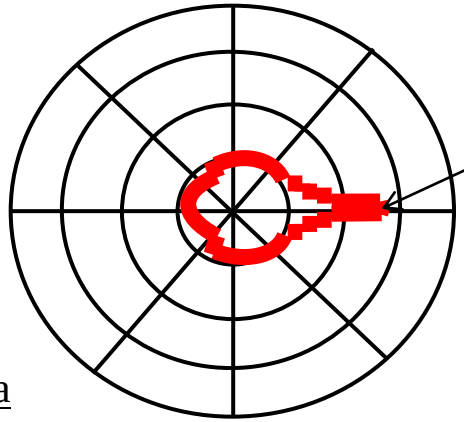
20dB below the min power necessary for desired communications.
Forced to use another frequency channel pair as it would require a very large and costly ultra high performance dish that exceeds the tower wind loading. An unnecessary waste of spectrum.

**The Difference Between 21st Century Antenna Systems and Traditional Dish Antennas**



1970s Dish Antenna

No change in antenna pattern



**Log Polar Plot of Antenna Gain dBi** **Log Polar Plot EIRP dBm**

# SUMMARY PART 1
# Innovative Solutions to the Fixed Wireless Spectrum Crunch under Existing Rules

## Benefits of Innovative Technologies vs Legacy (1970s) Technologies

- TTD Increases the Effective Use of Spectrum 100%
- TDD-TDMA Increases the Effective Use of Spectrum 1600%
- Among their many capabilities, Multi-Element Antennas have the ability to control side-lobe radiation by angle and therefore can prior coordinate when dish antennas cannot, thereby Conserving Spectrum.

# PART 2
# Innovative Solution to Mitigate the Fixed Wireless Spectrum Crunch Requiring a Rule Change

## Innovate - Optimize Operation under the Exclusive Use Rule

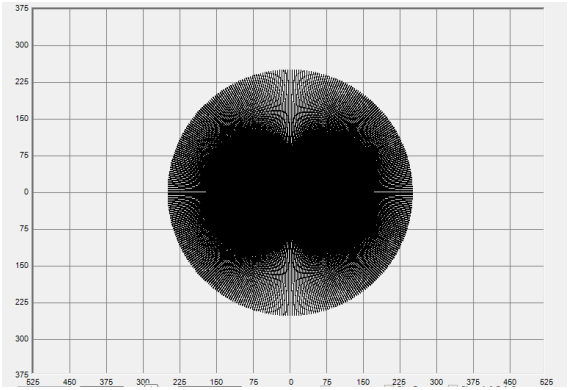
- Use Auxiliary stations instead of regular stations wherever possible

## Result

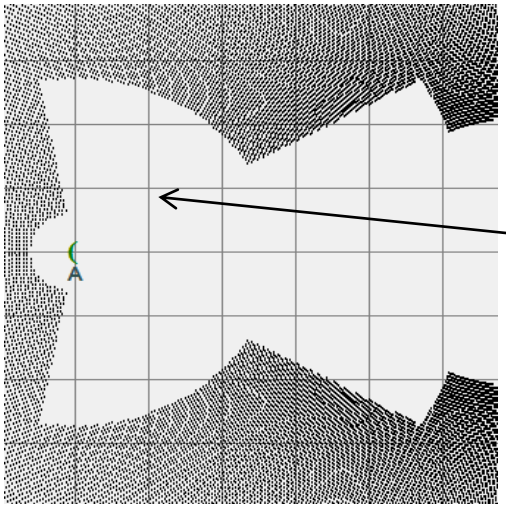
- 500MHz of "New "Spectrum Becomes Viable for 4G BH and Access
- Eliminates New Applicant Path Blockage
- Dramatically Increases Frequency Reuse
- Dramatically Lowers Costs for 4G BH and Access

**§ 101.103 Frequency coordination procedures.**
(a) Assignment of frequencies will be made only in such a manner as to facilitate the rendition of communication service on an interference-free basis in each service area. Unless otherwise indicated, each frequency available for use by stations in these services will be assigned exclusively to a single applicant in any service area.

**TSB 10-F Annex G.**
Interference analysis of a new applicant station is required within 125 miles, 250 miles within 5 degrees of the main beam azimuth.

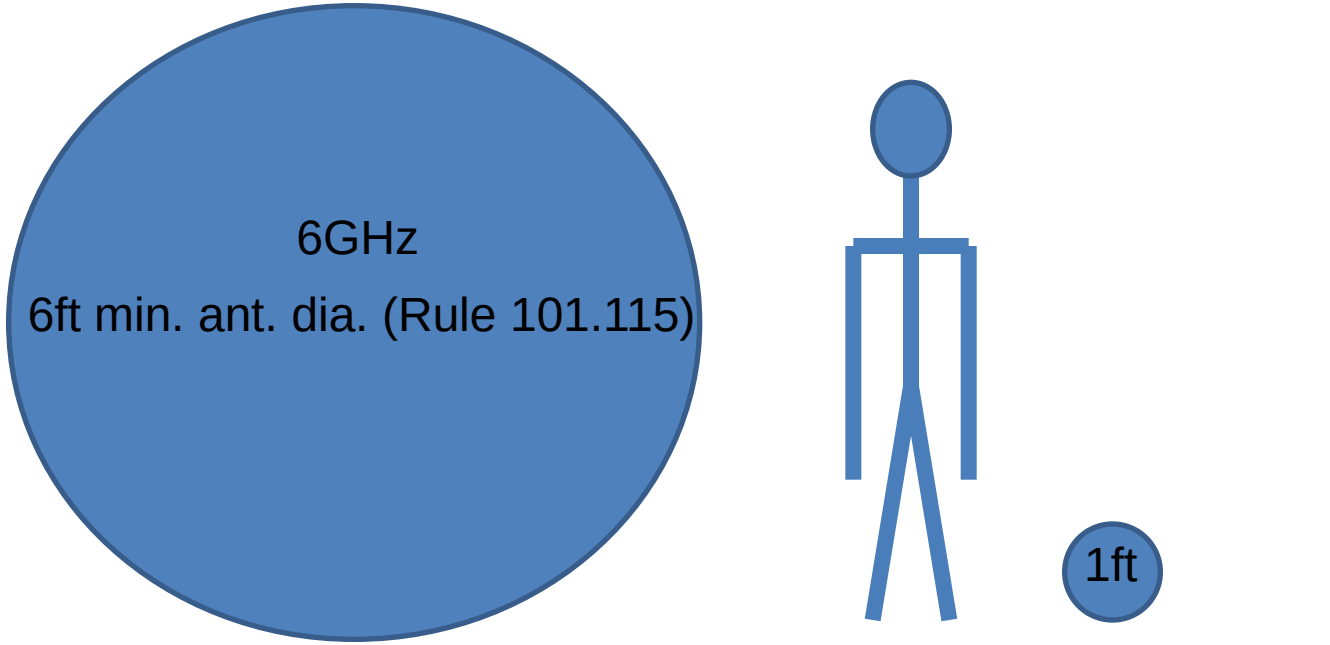



Computer Analysis of Over 1 Billion New Applicant Paths around a Licensed Path that may or may not coordinate (the potential to be blocked by one or both of the path's stations).




Interference Contour within which a new applicant will Not Prior Coordinate as it will Cause harmful interference**,** but where a Licensee can Deploy an Auxiliary Station and put the Wasted Spectrum to Productive Use.

# Innovative Solution to Mitigate the Fixed Wireless Spectrum Crunch Requiring a Rule Change




Cost approx $2000
Site Lease $600

Cost approx <$100
Site Lease $0 - $200

For the 500MHz of the lower 6GHz band to be usable for 4G, Enterprise and Consumer broadband the antenna size must be 1 - 2ft dia. and must not increase interference and path blockage. The solution: Auxiliary Stations

# Proposed Rule Change

**Legacy Approach**
**Primary Station**

- All stations must comply with Part 101 of the Rules including Rule 101.115

- All stations are given Primary status. (Meaning they are Protected from harmful interference by Regulation.)

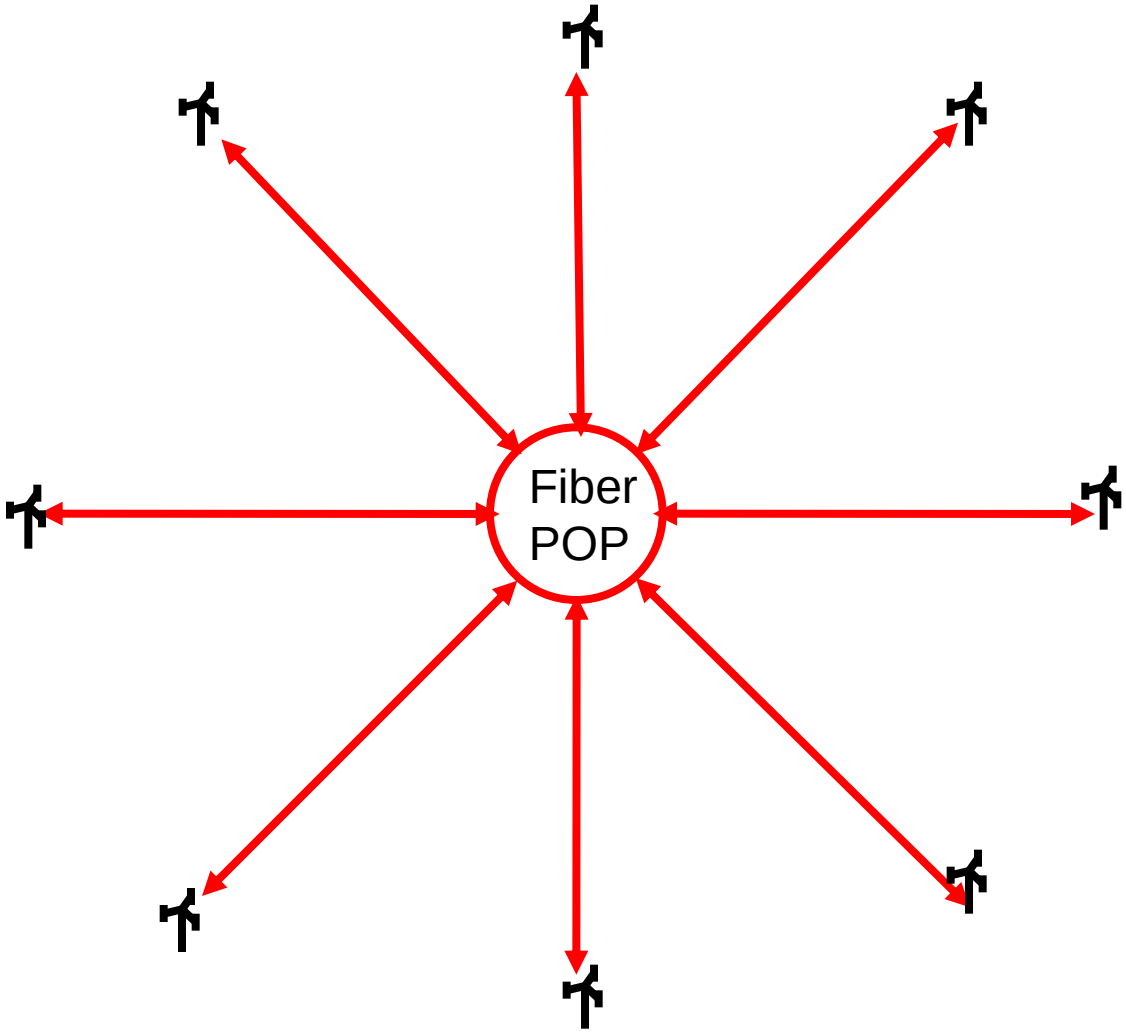
**Innovative Approach**
**Auxiliary Station**

- All auxiliary stations must comply with Part 101 of the Rules but are exempt from Part 101.115 of the Rules on a Secondary basis.

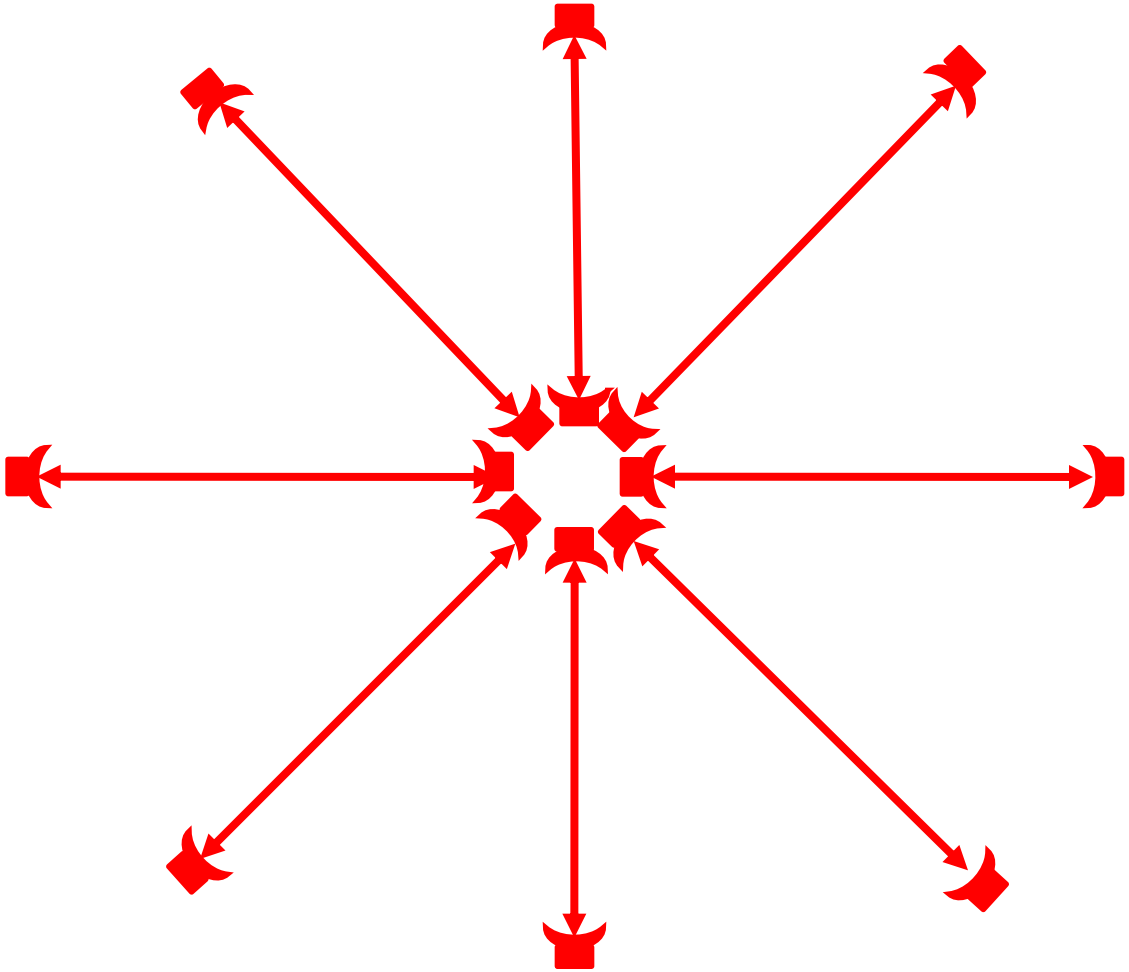
- All auxiliary stations are Secondary. (Meaning they have no regulatory protection from harmful interference and they must not cause harmful interference)

- All auxiliary stations must communicate with a Primary station

# Example of Cell Site Base Station Hub and Spoke Network
# Exclusive Use Under Rule 101.103



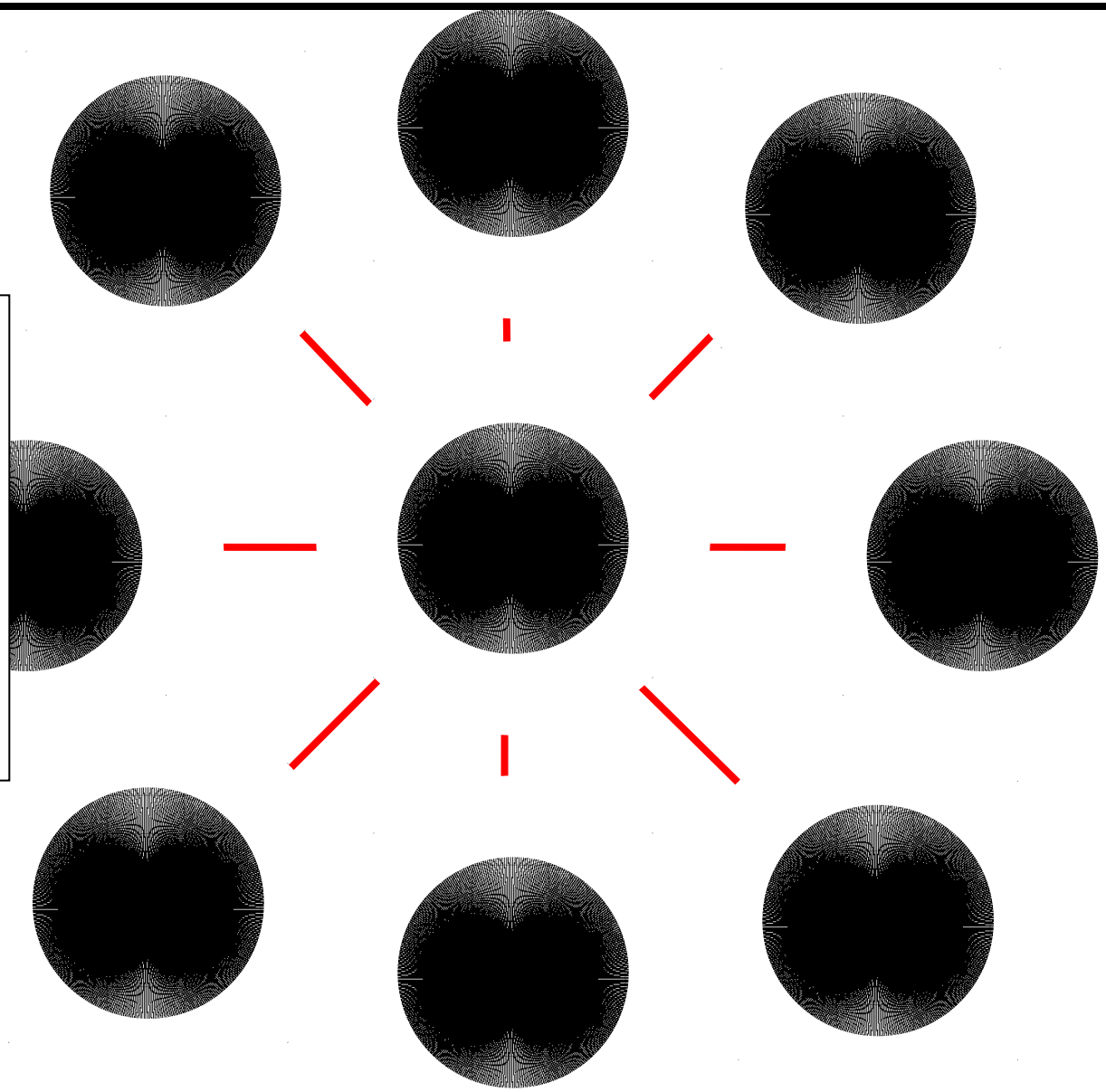
Maximum Number of Cell Site Base Stations Served with FDD Equipment and Legacy Dish Antennas Per Frequency Pair Under Rule 101.103 -- Approx Eight.



# Potential to Block New Applicant Paths

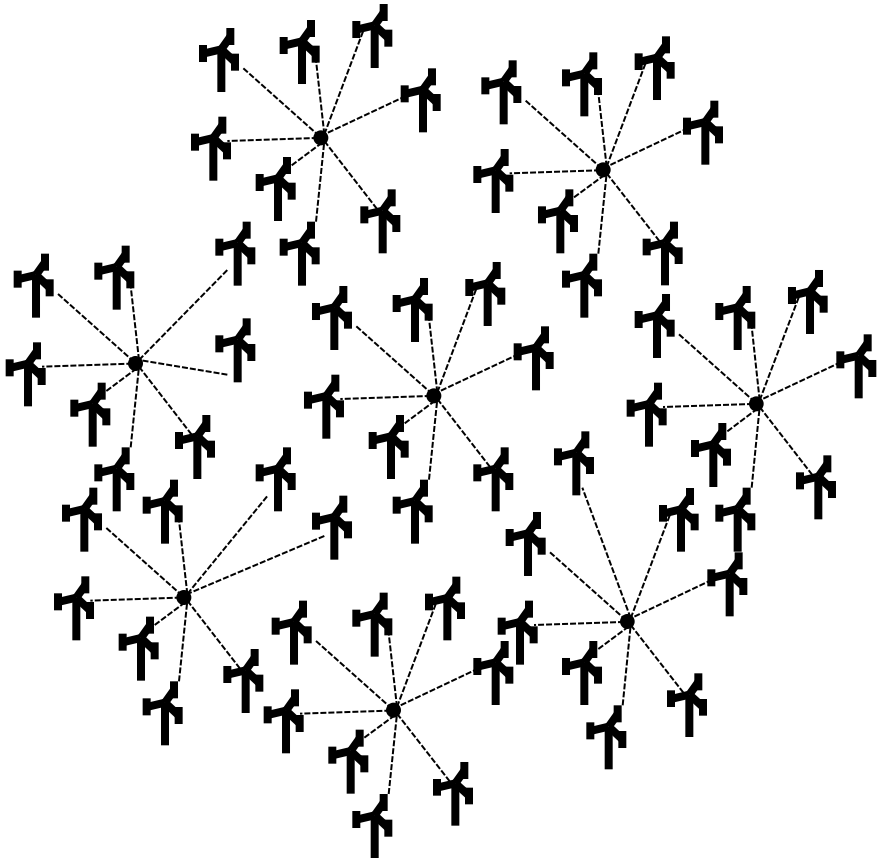
Each Station has the Potential to Block New Applicant Paths over an Area of approx 100,000 sq. miles.

Number of Stations with the potential to Block: Nine

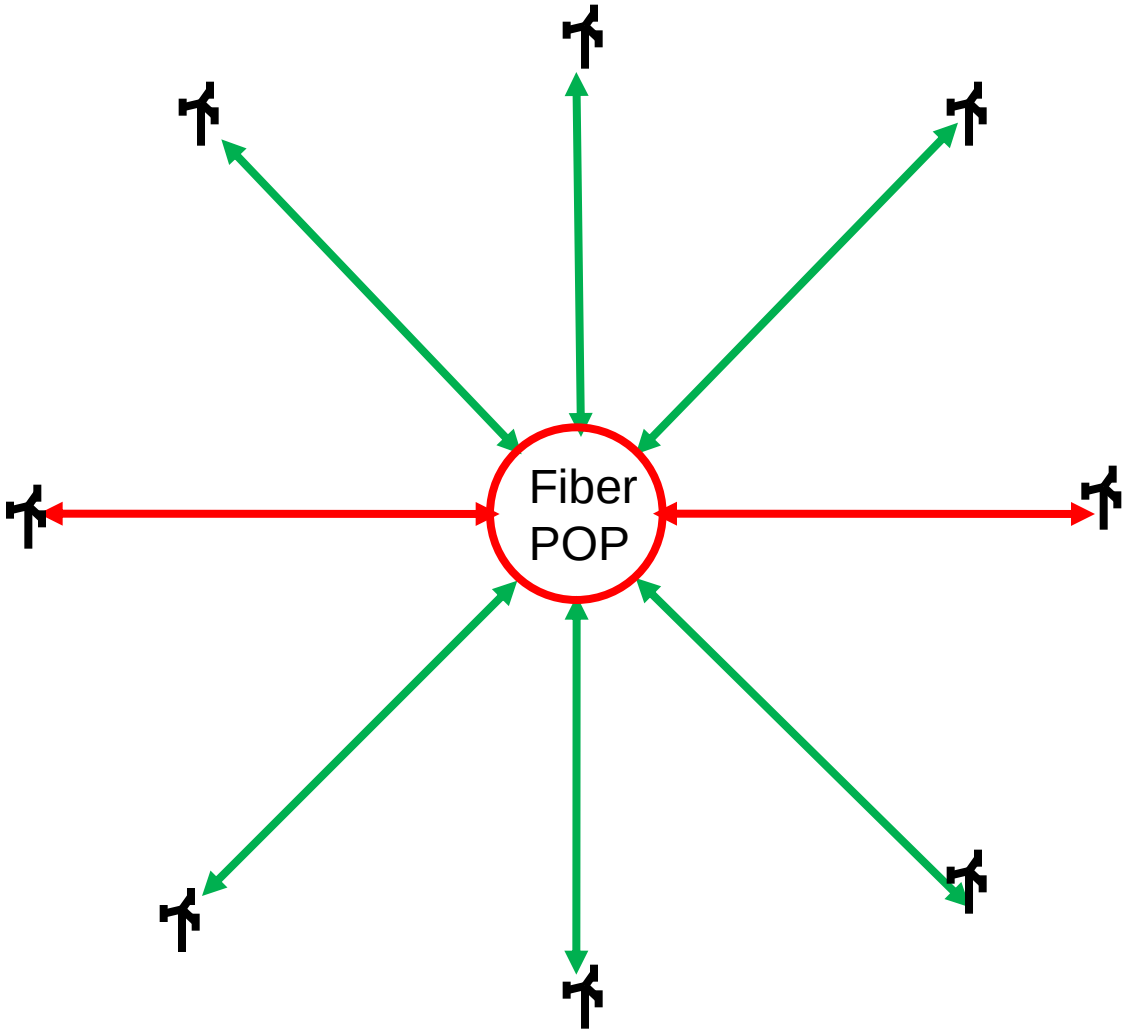


For illustration only. Not to scale.

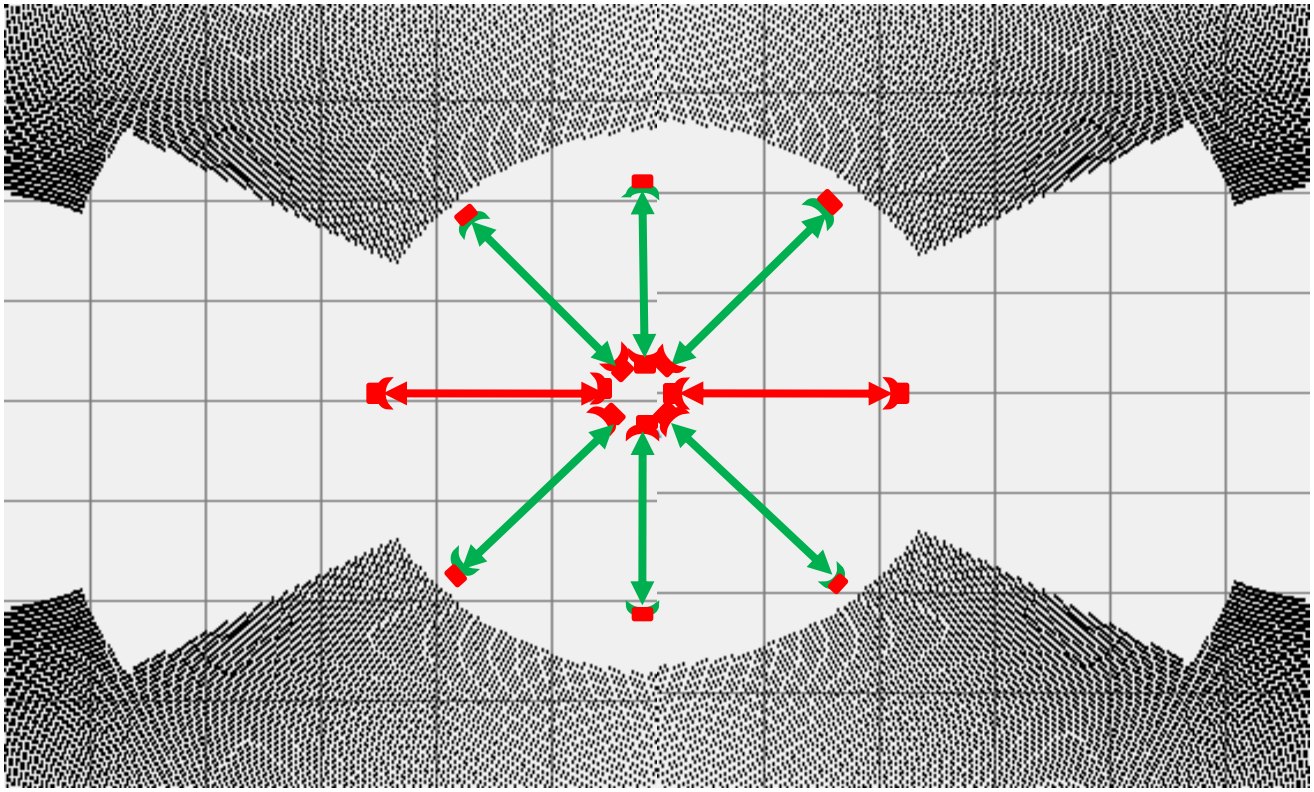
Ninety Six Cell Site Base Stations Served with FDD Equipment and Legacy Dish Antennas will Need Eight Channel Frequencies and have 104 Stations Each with the Potential to Block New Applicant Paths



Example of Cell Site Base Station Hub and Spoke Network
with Primary Stations and Auxiliary Stations



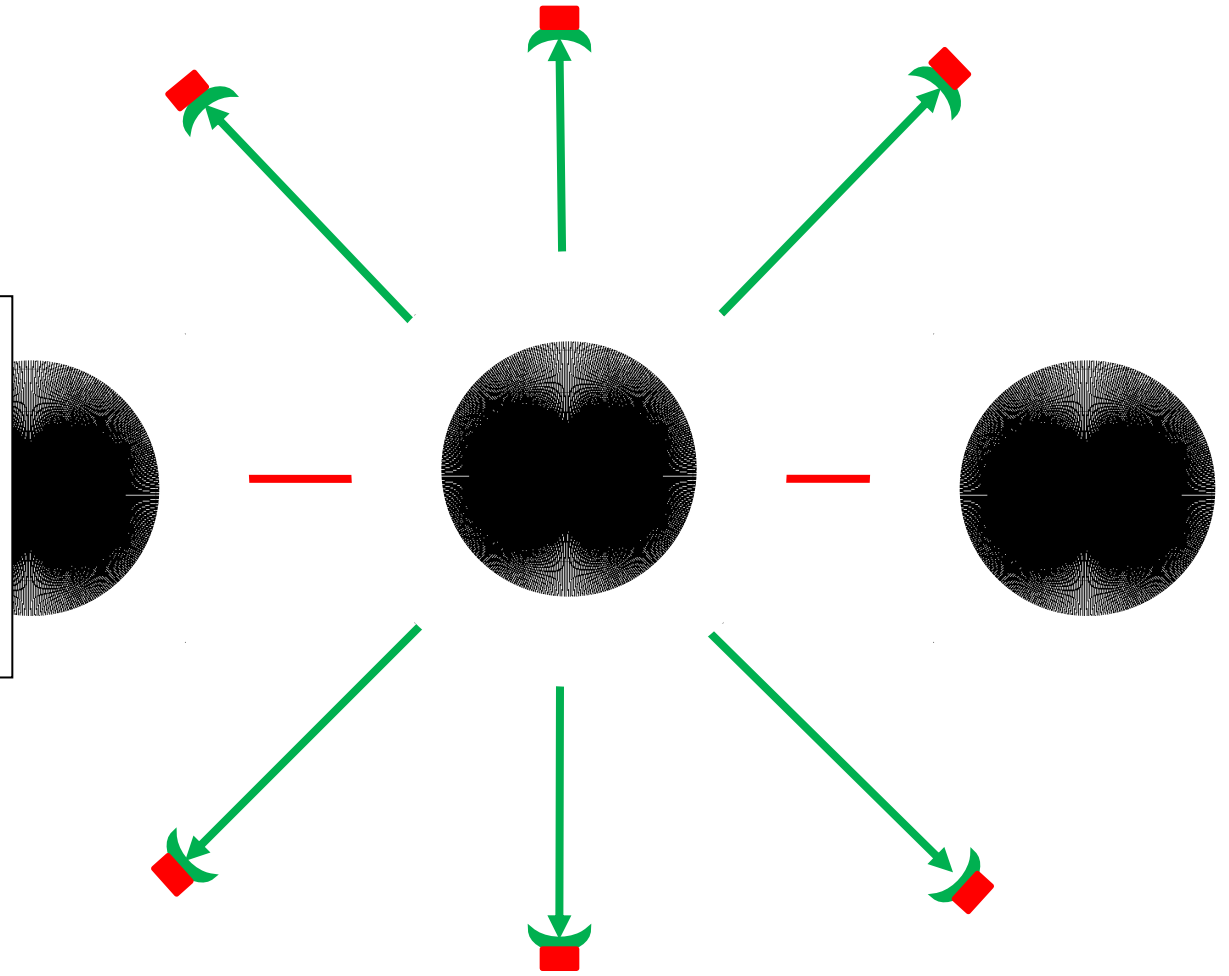
# The Case for Auxiliary Stations



By deploying auxiliary stations at locations within the Interference Contours of the licensed stations, protection against interference is achieved from the Primary stations.

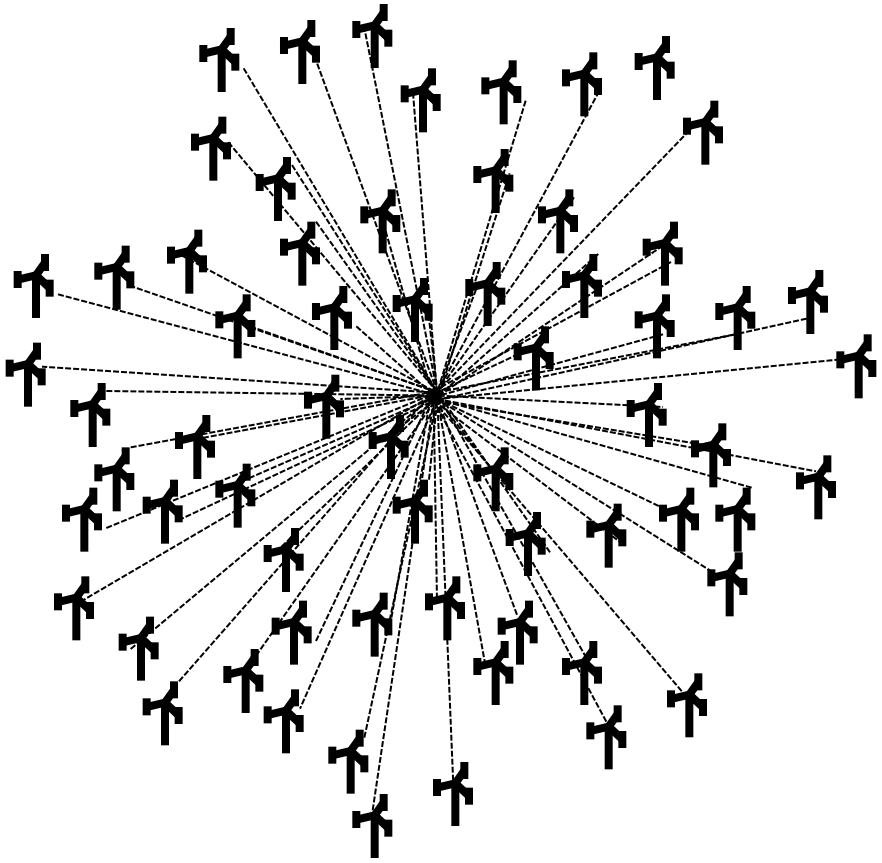
# The Case for Auxiliary Stations

Only three stations have the Potential to Block Numerous New Applicant Paths over an Area of approx 100 ,000sq. Miles.



For illustration only. Not to scale.

Ninety Six Cell Site Base Stations Served with TDD-TDMA Equipment and Multi-Element Antennas will Only Need One Channel Frequency and have Only Three Stations with the Potential to Block New Applicant Paths



# The Case for Auxiliary Stations

| **Primary Stations - Legacy Approach** | **Auxiliary Stations - Innovative Approach** |
|---|---|
| Minimum antenna size 6ft dia*. | No minimum antenna size |
| Esthetically prohibitive for all Consumer and most Enterprise and Backhaul | Ideal for ALL Consumer, Enterprise and Backhaul |
| Prohibitively Expensive for all Consumer and most Enterprise and Backhaul applications | Very inexpensive |
| Lower 6GHz band is not viable for Consumer Access and Most Enterprise and Backhaul. | 500MHz of the lower 6GHz band is made viable for Consumer Access, Enterprise and Backhaul. |
| Potential to Block New Paths | NO New Paths are Blocked! |
| | By innovative network design, auxiliary stations are protected by the "Mother Ship" – the Primary Stations. |

* 6GHz band

# How to Mitigate the Fixed Wireless Spectrum Crunch

1. Operate TDD
   Significantly Increases Spectrum Efficiency
2. Operate TDD-TDMA
   Dramatically Increases Spectrum Efficiency
   and decreases equipment costs
3. Use Multi-Element antennas
   Ideal for TDD-TDMA operation, increases spectrum reuse
   and lowers network costs

Industry has 11GHz TDD (software upgradable to TDD-TDMA) microwave radios and multi-element antenna systems certified to meet the requirements of Part 101 of the Rules, and are applying for licenses.

4. <u>Authorize the use of Auxiliary Stations</u>
   - ❖ Eliminates the blockage /potential blockage of new paths
   - ❖ Makes 500MHz of the lower 6GHz spectrum viable for 4G BH and access.
   - ❖ Dramatically lowers CAPEX and OPEX
   - ❖ No technology or interference risks

Industry has 6GHz TDD-TDMA microwave radios and multi-element antenna systems certified to meet the requirements of Part 101 of the Rules but there is no viable US market due to the prohibitively large antenna size due to Rule 101.115.

*It is time to move Fixed Microwave into the 21st Century.*